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(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent)*, DK (European patent), ES (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), SU, US.

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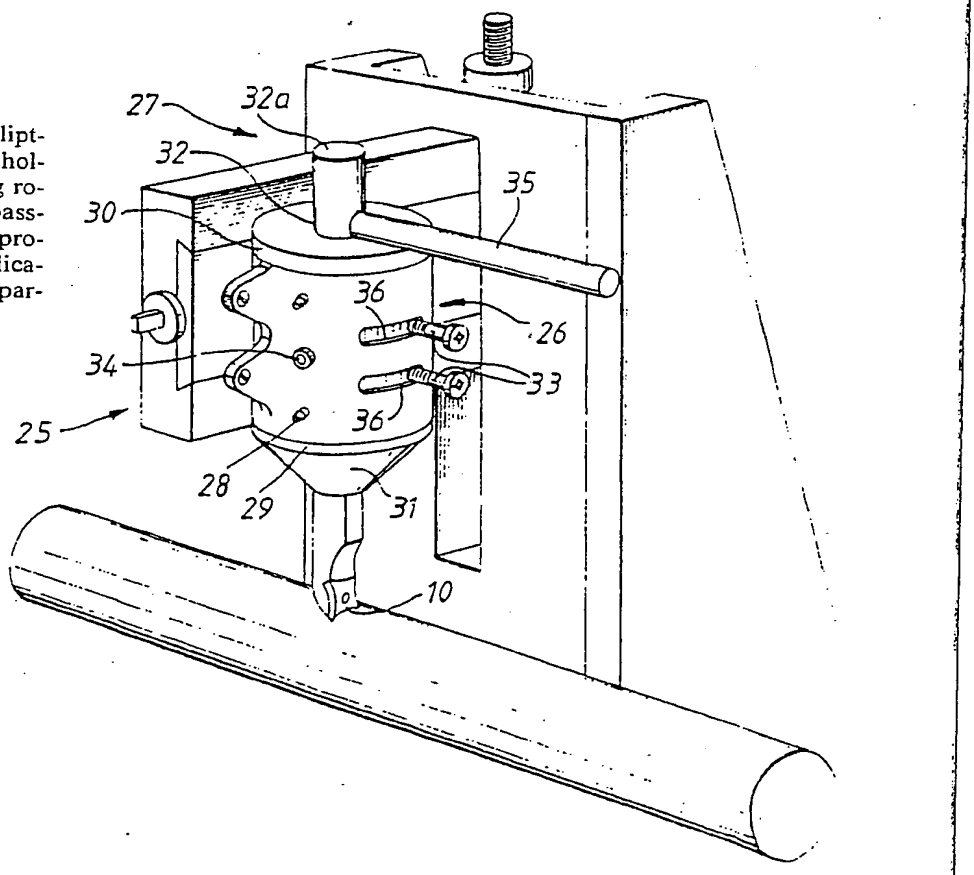
(54) Title: CUTTING TOOL

(57) Abstract

A cutting tool (10) has a part-elliptical symmetrical cutting edge (11). A holder (14) may be provided for allowing rotation of the tool (10) about an axis passing through its point of symmetry to provide a range of cutting radii. The application also includes the methods and apparatus utilising such tools.



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Cutting Tool

This invention relates to cutting tools and in particular, but not exclusively, to cutting tools for use in the removal of weld upset on the continuous weld produced during welded tube manufacture.

Current practice is to remove such scarf by drawing the tube under a cutting tool which has a radiused cutting edge which is intended to correspond closely with the outer radius of the tube so that a clean cut is achieved. The tools are, however, quite expensive and it is impractical to keep or manufacture a full set of tools dimensioned to cover the full range of tube sizes produced in a normal plant. Thus in practice, what occurs is that a compromise is reached between cost and efficiency of removal, with the result that the scarf removal does not match the radius of the tube or the surface of the tube is marked by the tool.

Proposals have been made to try to overcome this problem by rotating the tool, but because of the geometry of the radius the result is simply that the ends of the cutting tool dig in to the tube.

From one aspect the invention consists in a tool for removing burrs, scarf or the like from a circular cross-section body, the tool having a part elliptical symmetrical cutting edge.

Preferably, the cutting edge is constituted by less than a quarter of an ellipse so that the short axis of the

ellipse extends through the centre line of the cutting edge. In this arrangement the centre line portion of the cutting edge produces a radius for one size of body and a range of other radiuses can be achieved by rotating the cutting edge about an axis extending through its centre line because when viewed along that axis the cutting edge will tend to a radius as it is rotated. Thus instead of digging in to the tube, as is the case with a radiused cutting edge, the elliptical cutting edge tool provides an infinitely variable range of radii about the central value determined by the radius of the centre line portion when it is substantially coplanar with the cross-section of the tube.

Thus the cutting edge is preferably dimensioned such that it will conform with a range of body radii dependant of the rotational position of the cutting edge to the cross-sectional plane of the body.

When used in this way the cutting tool must be so formed as to provide the top rake and clearance angles required to allow for efficient cutting.

Grooves may be incorporated into the surface of the tool to provide control of the material being removed and to reduce any twisting moment on the material being scarfed.

It will be appreciated that the cutting tool may be in the form of a removable insert or may be constituted by an integral tool.

From another aspect the invention consists in apparatus for removing burrs, scarf or the like from a circular cross-section body comprising a tool having a part elliptical

symmetrical cutting edge, means for supporting the body and the tool for relative movement for causing the cutting edge to cut over a longitudinal track on the body and means for mounting the tool for rotation about an axis orthogonal to the axis of the body, when located on the support means, and passing through the point of symmetry of the cutting edge.

In a preferred embodiment the tool is mounted in a tool holder having means for adjusting the rotational position of the tool, the angle of cut and/or the longitudinal position of the tool.

The invention also consists in a method of removing scarf from a continuously formed tube by means of a cutting tool having a part-elliptical cutting edge and tube processed by this method.

Although the invention has been defined above it is to be understood it includes any inventive combination of the features set out above or in the following description.

The invention may be performed in various ways and a specific embodiment will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1a illustrates a cutting tool held at an angle of twist to a tube as viewed from above;

Figure 1b is an end view of the arrangement of Figure 1;

Figure 1c is a side view of that arrangement;

Figure 2a is a front view of the cutting tool of Figure 1 mounted in a tool holder;

Figure 2b is a side view of that tool holder;

Figures 3a to 3c correspond to Figures 1a to 1c but with the tool inclined;

Figures 4a and b correspond to Figures 2a and 2b, but again with the tool inclined;

Figure 5 is a perspective view of a practical apparatus showing the tool in the form of an insert;

Figure 6 is an enlarged front view of an insert; and

Figure 7 is a sectional view through the insert of Figure 6 along the line VII-VII.

As has been mentioned above the invention consists in a cutting tool 10 having a part-elliptical symmetrical cutting edge such as is shown at 11. It has been determined that if such a tool is rotated about its point of symmetry 12 in either direction it will tend towards a radius and hence, in any given rotational position (or for any given angle of twist), will provide a cutting edge of a given radius at the point of the cutting edge 11 which engages a tube 13 passing below it.

For any given tool it has been found that rotation causes the ellipse to pass through a minimum radius and a particular maximum angle of twist is illustrated in Figure 1a. This angle of twist gives the minimum tube diameter which can be processed by that tool as shown in Figure 1b. The actual dimensions of the cutting edge 11 are determined as a function of the desired minimum tube diameter, the angle of twist and the cutting angle and clearance indicated in Figure 1b.

Conveniently the cutting tool 10 can be mounted in a tool holder 14 which is in turn mounted for rotation and axial displacement on a tool post slide 15. The tool holder should be arranged such that its axis of rotation 20 is orthogonal to the workpiece axis 21 and passes through the cutting edge 11 at the point of symmetry 12. This prevents the points 16 of the tool digging into the workpiece when in a rotated position.

However with a conventionally shaped tool such a position means that there is no clearance angle or rake angle and the tool would therefore be unsuitable for use on many materials. This can either be overcome by holding the tool at an angle as shown in Figures 3 and 4 or by shaping the tool 10 in such a way as to provide both the clearance angle and the rake angle on the tool. This can be clearly seen in Figure 7 where the tool is formed with a central well 23 to provide the rake angle and is inclined at 24 to provide the clearance angle. The former solution is easier to manufacture and is more compatible with existing systems. In either case the axis 20 passes through the point of symmetry 12.

Turning to Figure 5 a practical construction is generally indicated at 25. Here a tool holder 26 is supported on a conventional slide mechanism, generally indicated at 27 which allows for vertical and lateral positioning of the holder 26. The holder 26 comprises a cylindrical sleeve 28, which supports a barrel 29 having an upper annular flange 30 to lock it on the sleeve and a

frustoconical lower end 31. A bore 32 extends through the barrel to receive a tool support 32a which holds the tool 10 at its lower end. The support 32a can be locked into the barrel by means of screws 33 and the barrel can be locked into any selected rotational position by lock nut 34. For convenience the barrel is provided with a handle 35 so that the tool can be rotated into its selected operating position. It will be seen that slots 36 are provided in the sleeve 28 to allow this rotation.

In certain cases it may not be economic to retrofit such an arrangement and in this case a customer may be provided with a set of tool supports 32a or integral tools in which the cutting edge is effectively set at a particular angle of rotation. The appropriate tool for any shape can then be quickly selected and when used in this configuration the tool/insert will cover a greater range of tube sizes than currently available designs.

It will be understood that the new form of cutting tool will enable manufacturers to reduce their stock of tools and achieve better conformity between the effective cutting edge radius and the radius of the tube. In addition the scarf removing apparatus of which the tool forms a part can be adjusted simply by rotating the tool 10, over a range of radii, and this makes the apparatus particularly suitable for automatic operation by computer. Indeed the apparatus might include a number of tools with their given edges dimensioned to cover a wide range of radii and the control unit could simply lower the appropriate tool in a selected

rotational position for a particular size of tube to be processed at the moment. Where the ranges overlap between cutting tools the computer could select the appropriate tool depending on the relative wear that had taken place.

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CLAIMS

1. A tool for removing burrs, scarf or the like from a circular cross-section body, the tool having a part elliptical symmetrical edge.

2. A tool as claimed in Claim 1, wherein the cutting edge is constituted by less than a quarter of an ellipse.

3. A tool as claimed in Claim 1 or Claim 2 wherein the short axis of the ellipse extends through the centre line of the cutting edge.

4. A tool as claimed in Claim 1 in the form of an insert.

5. A tool as claimed in Claim 4, wherein the insert is sintered.

6. A tool substantially as hereinbefore described with reference to the accompanying drawings.

7. Apparatus for removing burrs, scarf or the like from a circular cross-section body comprising a tool having a part elliptical symmetrical cutting edge, means for supporting the body and the tool for relative movement for causing the cutting edge to cut over a longitudinal track on the body and means for mounting the tool for rotation about an axis orthogonal to the axis of the body, when located on the support means, and passing through the point of symmetry of the cutting edge.

8. Apparatus as claimed in Claim 1, wherein mounting means includes a tool holder.

9. Apparatus as claimed in Claim 7 or Claim 8 further

comprising means for adjusting the rotational position of the tool, the angle of cut and/or the longitudinal position of the tool.

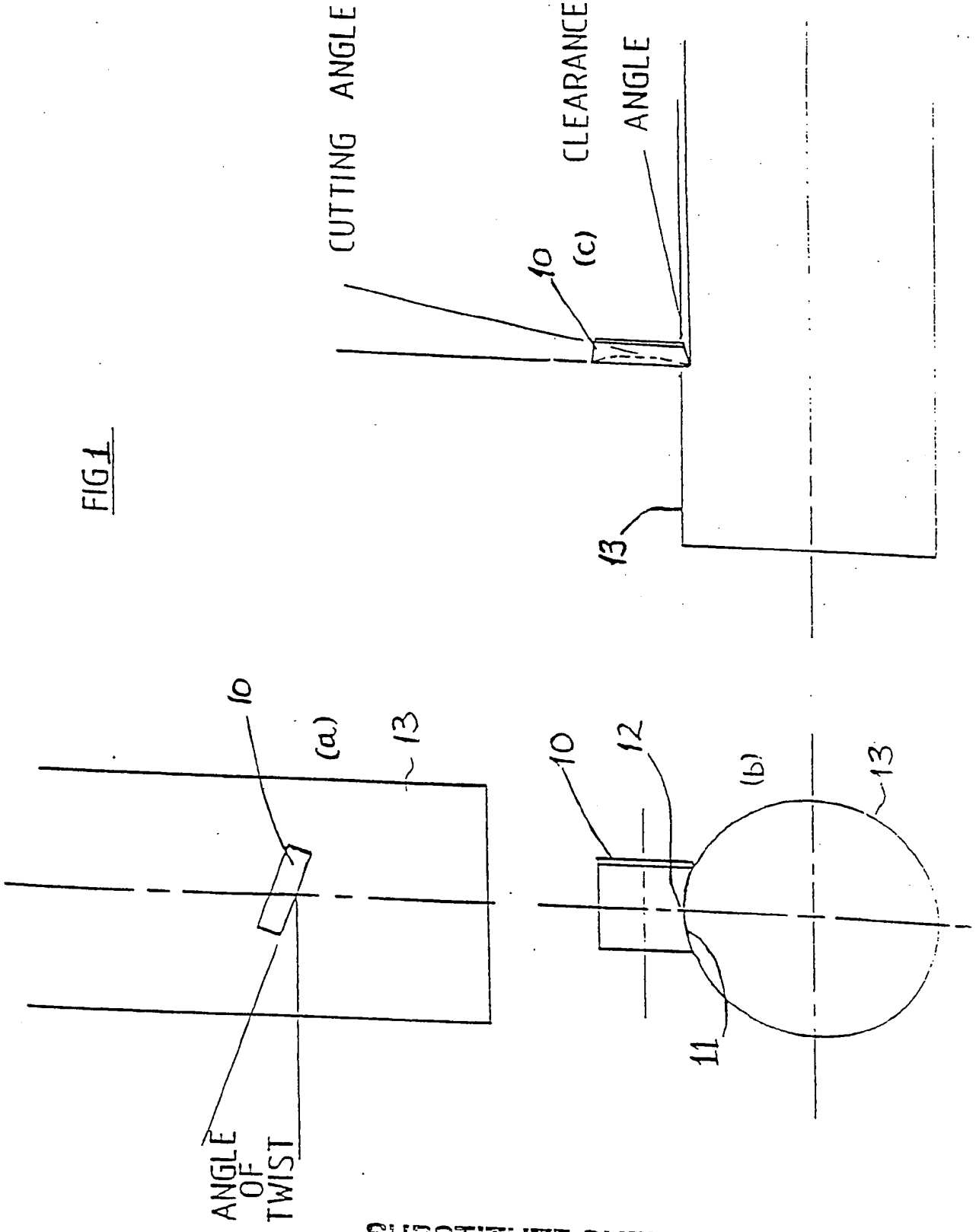
10. Apparatus as claimed in any one of Claims 7 to 9, wherein the tool is a tool as claimed in any one of Claims 1 to 6.

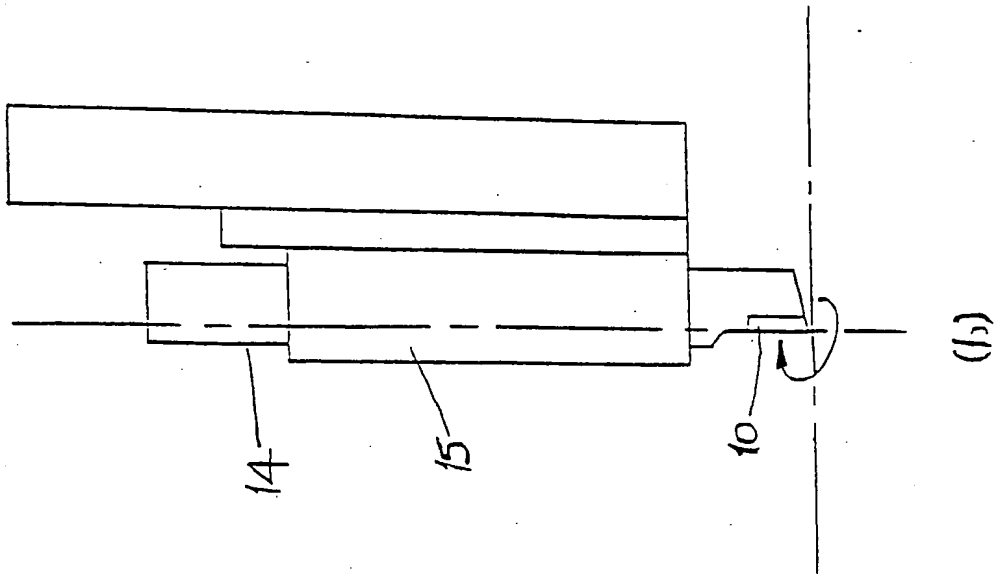
11. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

12. A method of removing scarf ulitising the tool of any one of Claims 1 to 6 or the apparatus of Claims 7 to 11.

13. A tube treated by a tool of Claims 1 to 6, the apparatus of Claims 7 to 11 or the method of Claim 12.

FIG 1





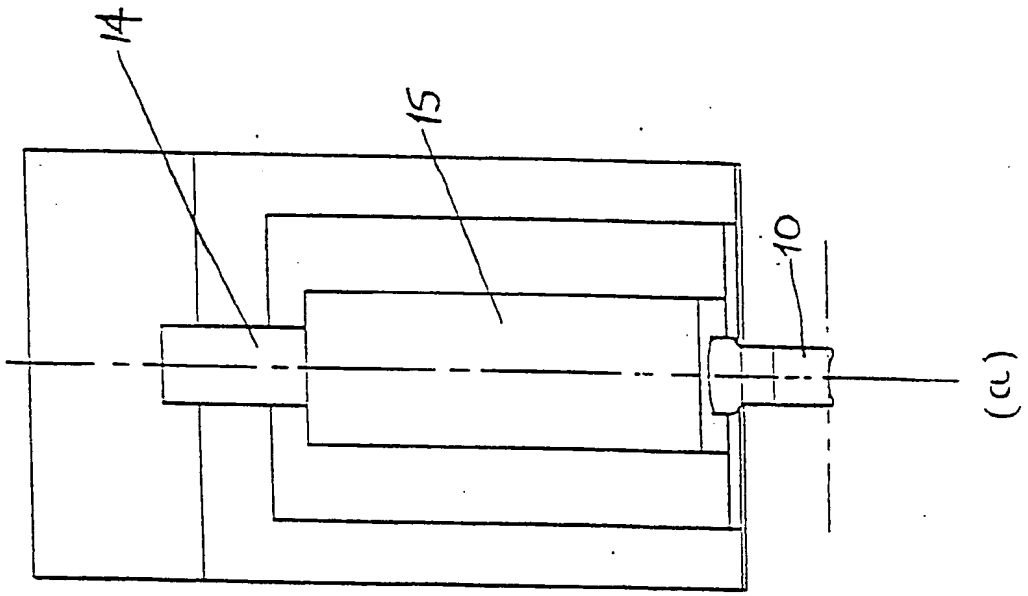
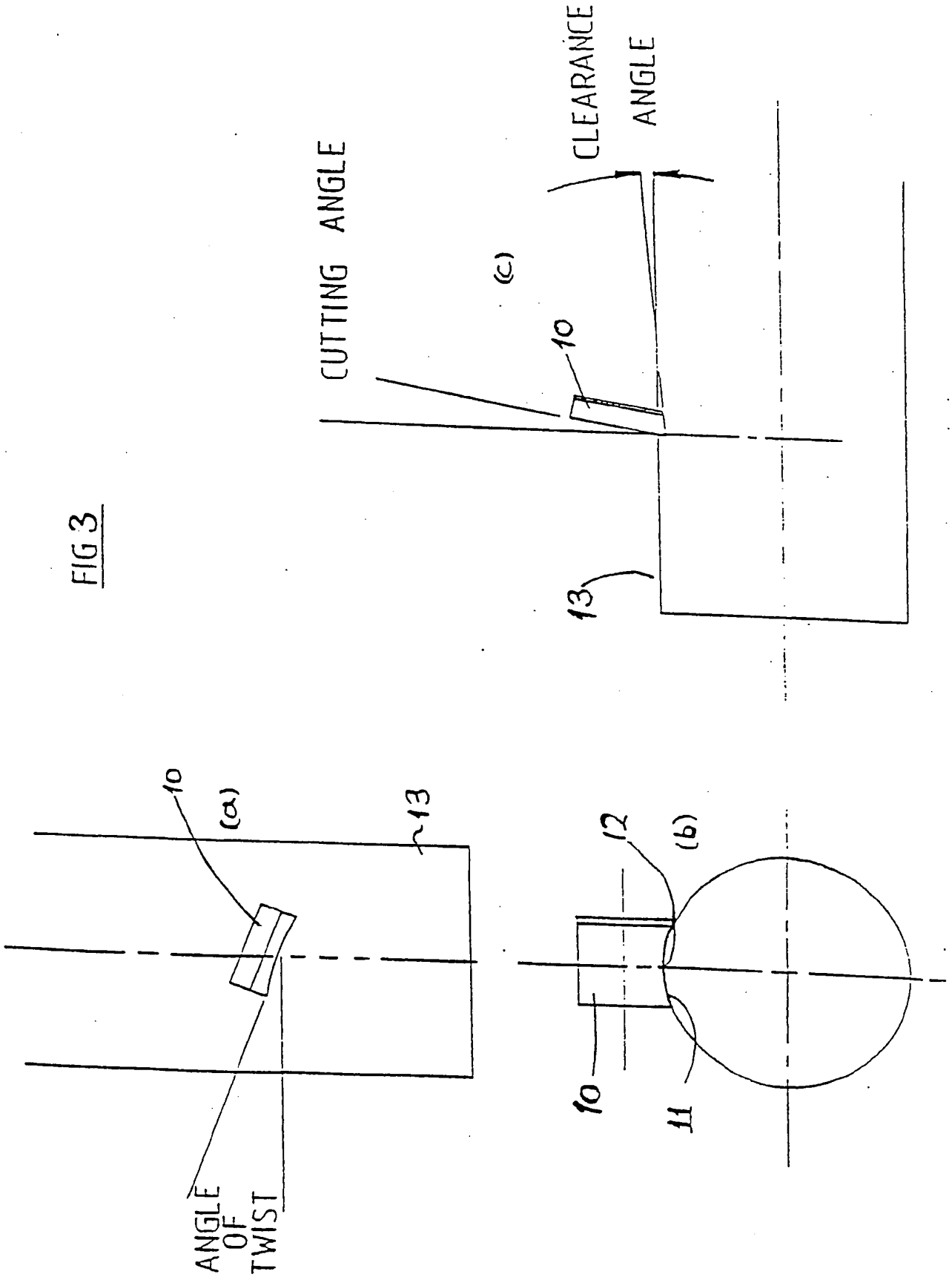


FIG 2

FIG 3



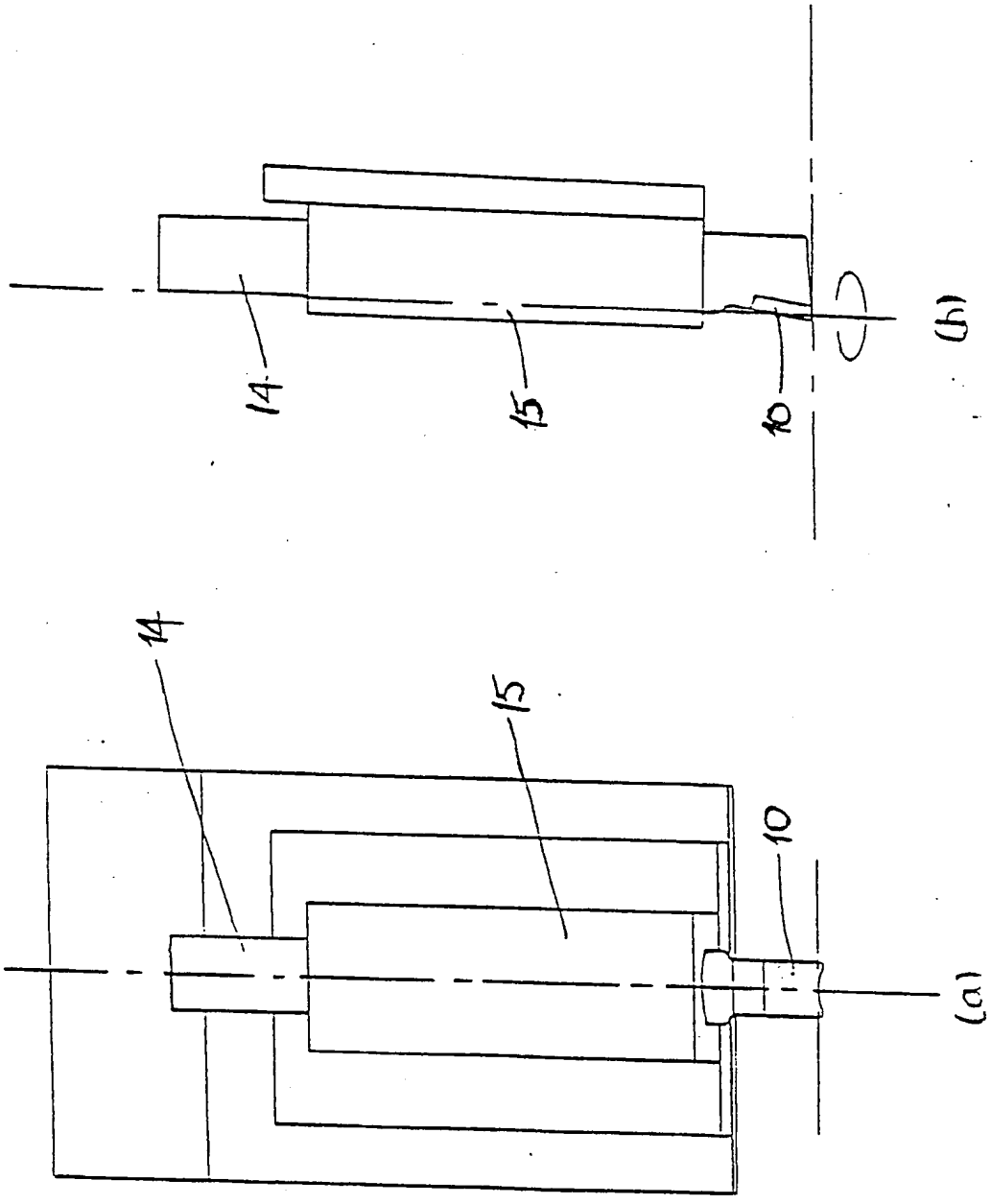


FIG 4

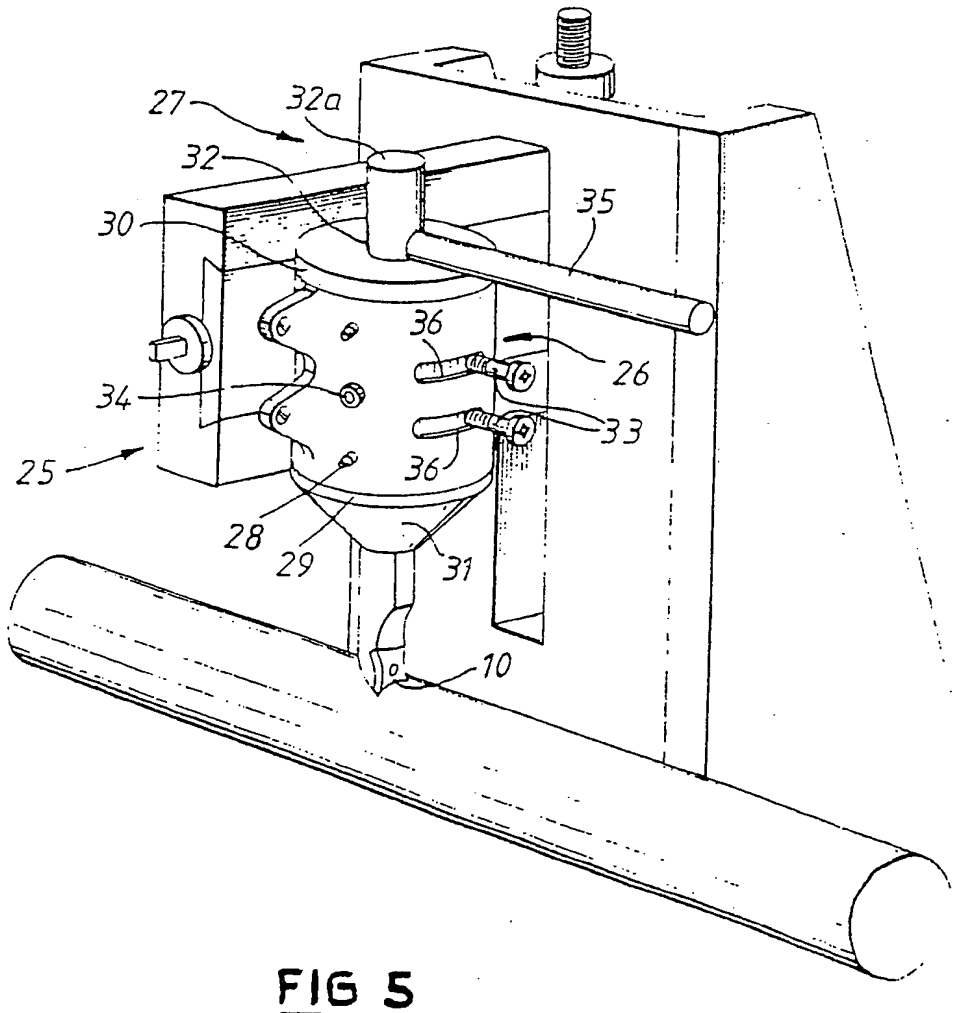


FIG 5

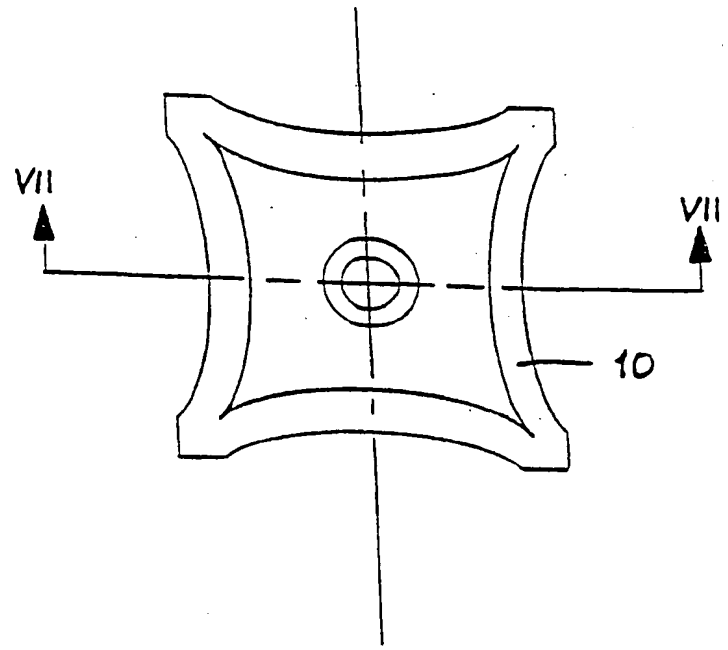


FIG 6

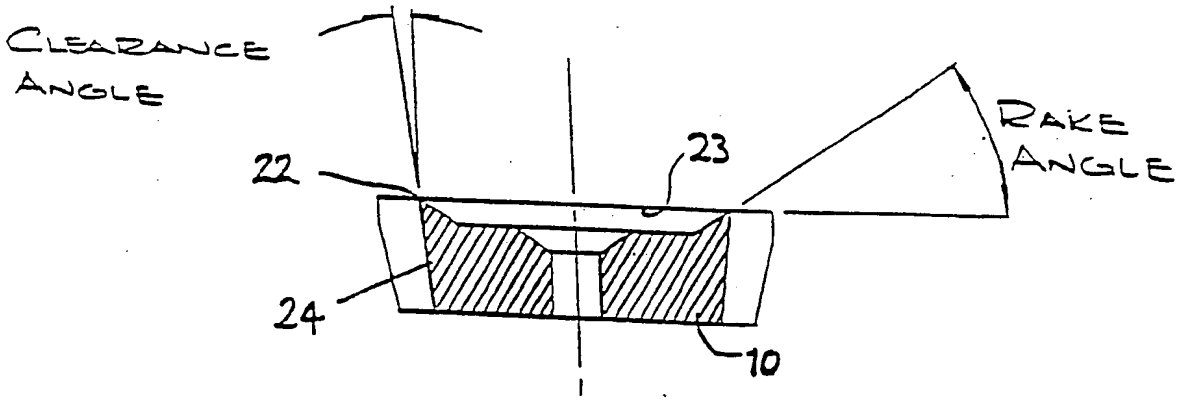


FIG 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01147

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: B 23 D 79/02, 13/00, 27/14

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System [8]	Classification Symbols
IPC[5]	B 23 D 79/00, 13/00, 27/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [9]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with Indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, A, 3758740 (DUPY) 11 September 1973 see column 3, lines 42-54; figures 1,4,7,8	1,6,7
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Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3758740	11-09-73	None	
US-A- 3755884	04-09-73	None	
FR-A- 2475438	14-08-81	None	

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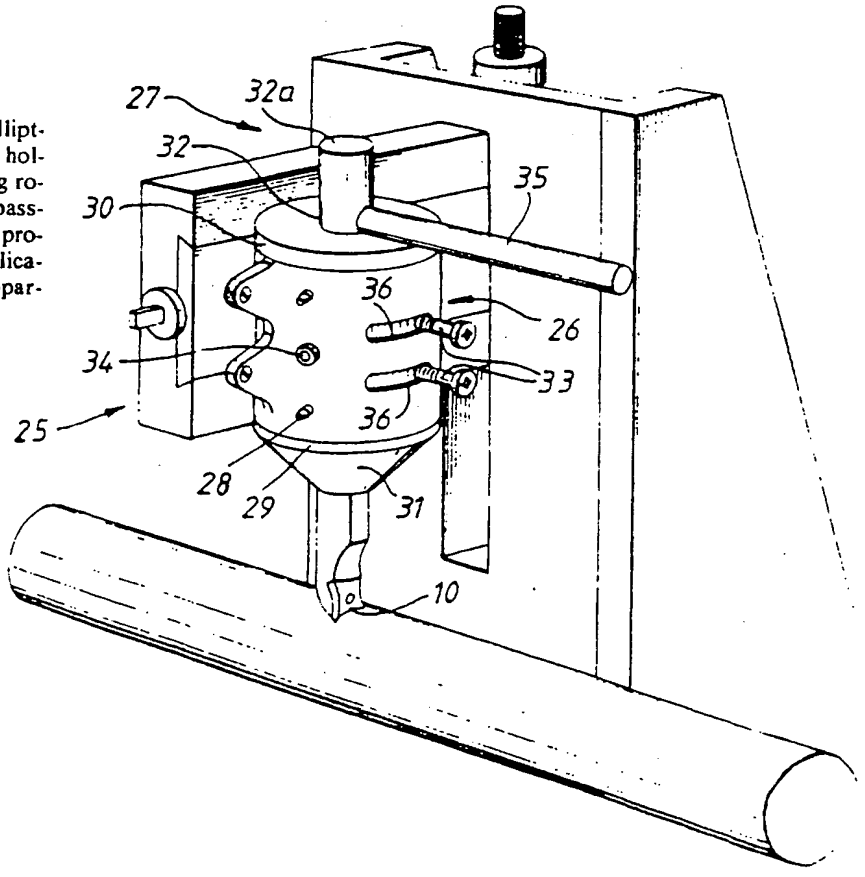

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